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Sparse bayesian learning and the relevance vector machine

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↑ ABSTRACT

This paper introduces a general Bayesian framework for obtaining sparse solutions to regression and classification tasks utilising models linear in the parameters. Although this framework is fully general, we illustrate our approach with a particular specialisation that we denote the 'relevance vector machine' (RVM), a model of identical functional form to the popular and state-of-the-art 'support vector machine' (SVM). We demonstrate that by exploiting a probabilistic Bayesian learning framework, we can derive accurate prediction models which typically utilise dramatically fewer basis functions than a comparable SVM while offering a number of additional advantages. These include the benefits of probabilistic predictions, automatic estimation of 'nuisance' parameters, and the facility to utilise arbitrary basis functions (e.g. non-'Mercer' kernels). We detail the Bayesian framework and associated learning algorithm for the RVM, and give some illustrative examples of its application along with some comparative benchmarks. We offer some explanation for the exceptional degree of sparsity obtained, and discuss and demonstrate some of the advantageous features, and potential extensions, of Bayesian relevance learning.

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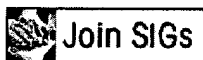
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1 [Tutorial: Tutorial on using support vector machines and Java to create an ambient information system](#)

Rasmus Ulslev Pedersen

November 2004 **Proceedings of the 2nd European Union symposium on Ambient intelligence**Full text available: [pdf\(136.39 KB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

The tutorial T2: Designing and Implementing an Intelligent Ubiquitous Information System in Java at EUSAI 2004 introduces the concepts and tools necessary for the participants to develop intelligent agentbased information systems. The potent and flexible support vector machine learning algorithm -upon which the agents base their intelligence- is an integral part of the session. Most importantly, we demonstrate and explain how to use support vector machines to implement a ubiquitous distribute ...

Keywords: agents, applets, classification, distributed systems, implementation, information systems, mobile computing, open source, support vector machine, ubiquitous

2 [Probability Product Kernels](#)

Tony Jebara, Risi Kondor, Andrew Howard

August 2004 **The Journal of Machine Learning Research**, Volume 5Full text available: [pdf\(366.14 KB\)](#)Additional Information: [full citation](#), [abstract](#)

The advantages of discriminative learning algorithms and kernel machines are combined with generative modeling using a novel kernel between distributions. In the probability product kernel, data points in the input space are mapped to distributions over the sample space and a general inner product is then evaluated as the integral of the product of pairs of distributions. The kernel is straightforward to evaluate for all exponential family models such as multinomials and Gaussians and yields int ...

3 [Combining pairwise sequence similarity and support vector machines for remote protein homology detection](#)

Li Liao, William Stafford Noble

April 2002 **Proceedings of the sixth annual international conference on Computational biology**Full text available: [pdf\(1.38 MB\)](#)Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

One key element in understanding the molecular machinery of the cell is to understand the

meaning, or function, of each protein encoded in the genome. A very successful means of inferring the function of a previously unannotated protein is via sequence similarity with one or more proteins whose functions are already known. Currently, one of the most powerful such homology detection methods is the SVM-Fisher method of Jaakkola, Diekhans and Haussler (ISMB 2000). This method combines a generative, ...

4 Sparse bayesian learning and the relevance vector machine

Michael E. Tipping

September 2001 **The Journal of Machine Learning Research**, Volume 1

Full text available:  [pdf\(999.88 KB\)](#) Additional Information: [full citation](#), [abstract](#)

This paper introduces a general Bayesian framework for obtaining sparse solutions to regression and classification tasks utilising models linear in the parameters. Although this framework is fully general, we illustrate our approach with a particular specialisation that we denote the 'relevance vector machine' (RVM), a model of identical functional form to the popular and state-of-the-art 'support vector machine' (SVM). We demonstrate that by exploiting a probabilistic Bayesian learning framework ...

5 Poster: A single-sensor hand geometry and palmprint verification system

Michael Goh Kah Ong, Tee Connie, Andrew Teoh Beng Jin, David Ngo Chek Ling

November 2003 **Proceedings of the 2003 ACM SIGMM workshop on Biometrics methods and applications**

Full text available:  [pdf\(378.05 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Several contributions have shown that fusion of decisions or scores obtained from various single-modal biometrics verification systems often enhances the overall system performance. A recent approach of multimodal biometric systems with the use of single sensor has received significant attention among researchers. In this paper, a combination of hand geometry and palmprint verification system is being developed. This system uses a scanner as sole sensor to obtain the hands images. First, the han ...

Keywords: fusion, hand geometry, multimodal biometric, palmprint

6 Face recognition: A literature survey

W. Zhao, R. Chellappa, P. J. Phillips, A. Rosenfeld

December 2003 **ACM Computing Surveys (CSUR)**, Volume 35 Issue 4

Full text available:  [pdf\(4.28 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)


As one of the most successful applications of image analysis and understanding, face recognition has recently received significant attention, especially during the past several years. At least two reasons account for this trend: the first is the wide range of commercial and law enforcement applications, and the second is the availability of feasible technologies after 30 years of research. Even though current machine recognition systems have reached a certain level of maturity, their success is ...

Keywords: Face recognition, person identification

7 Randomized Variable Elimination

David J. Stracuzzi, Paul E. Utgoff

December 2004 **The Journal of Machine Learning Research**, Volume 5

Full text available:  [pdf\(273.39 KB\)](#) Additional Information: [full citation](#), [abstract](#)

Variable selection, the process of identifying input variables that are relevant to a particular learning problem, has received much attention in the learning community. Methods that


employ a learning algorithm as a part of the selection process (wrappers) have been shown to outperform methods that select variables independently from the learning algorithm (filters), but only at great computational expense. We present a randomized wrapper algorithm whose computational requirements are within a c ...

8 Research track posters: A DEA approach for model combination



Zhiqiang Zheng, Balaji Padmanabhan, Haoqiang Zheng

August 2004 **Proceedings of the 2004 ACM SIGKDD international conference on Knowledge discovery and data mining**

Full text available:  [pdf\(241.59 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

This paper proposes a novel Data Envelopment Analysis (DEA) based approach for model combination. We first prove that for the 2-class classification problems DEA models identify the same convex hull as the popular ROC analysis used for model combination. For general k-class classifiers, we then develop a DEA-based method to combine multiple classifiers. Experiments show that the method outperforms other benchmark methods and suggest that DEA can be a promising tool for model combination.

Keywords: ROC, data envelopment analysis, model combination

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Transmitted energy which is modulated in order to carry information. Usually, it is in the form of a radio-frequency sine wave, modulated either in amplitude or in frequency.

www.novalynx.com/glossary.html

Transmitted energy which is modulated in order to carry information. Usually, it is in the form of a radio- frequency sine wave, modulated either in amplitude or in frequency.

www.telemet.com/weather_gloss_c.htm

The wave, usually of radio frequency, whose characteristics are modified in the process of modulation.

mark.foster.cc/school/phys100.html

An electromagnetic wave that is emitted by a radio transmitter in order to carry information. The information is superimposed onto the carrier by making small changes to either its amplitude or its frequency.

www.nsb.northants.sch.uk/Web%20Pages/science/Physics%20Dictionary.htm

A wave generated at a point in the transmitting system and modulated by the signal.

roland.grc.nasa.gov/~dgllover/dictionary/c.html

A high-frequency wave that can be sent through the air and is modulated by a lower-frequency wave containing information. 14.6

highered.mcgraw-hill.com/sites/0072492260/student_view0/glossary.html

An analog signal used in the transmission of electric signals.

www.indstate.edu/cape/glossary.html

– Energy wave (e.g., electricity or light) that carries encoded messages within a communication channel.

averia.unm.edu/sa3e_student/Glossary.html

Carrier waves are used to carry information from transmitter to receiver. The carrier wave will be radio or microwave frequency. There are two methods of using the carrier wave to carry information - amplitude modulation and frequency modulation. In radio transmissions for example, the carrier is of a much higher frequency than the audio wave which is to be transmitted. The higher the frequency of the carrier, the higher the quality of the transmitted signal.

www.users.zetnet.co.uk/computing/MainPage/SecDepts/Physics/Resources/Glossary/Glossary_of_Terms.t

Synonym carrier (cxr) (def. #2).

www.bandwidthmarket.com/resources/glossary/C2.html

A high-frequency electromagnetic wave capable of being modulated to transmit a signal of lower frequency.

www.fact.usu.edu/ece3260/Module5/Lesson5/ece260Gloss22.htm

The radio frequency wave generated at a transmitting station for the purpose of carrying the modulated or audio frequency.

homepages.bw.edu/~kweiss/glossary/c.html

a radio wave that can be modulated in order to transmit a signal

www.cogsci.princeton.edu/cgi-bin/webwn


define: carrier wave

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Definitions of **carrier** on the Web:

someone whose employment involves carrying something; "the bonds were transmitted by carrier"
www.cogsci.princeton.edu/cgi-bin/webwn

a self-propelled wheeled vehicle designed specifically to carry something; "refrigerated carriers have revolutionized the grocery business"
www.cogsci.princeton.edu/cgi-bin/webwn

aircraft carrier: a large warship that carries planes and has a long flat deck for take-offs and landings
www.cogsci.princeton.edu/cgi-bin/webwn

an inactive substance that is a vehicle for a radioactive tracer of the same substance and that assists in its recovery after some chemical reaction
www.cogsci.princeton.edu/cgi-bin/webwn

a person or firm in the business of transporting people or goods or messages
www.cogsci.princeton.edu/cgi-bin/webwn

carrier wave: a radio wave that can be modulated in order to transmit a signal
www.cogsci.princeton.edu/cgi-bin/webwn

mailman: a man who delivers the mail
www.cogsci.princeton.edu/cgi-bin/webwn

a boy who delivers newspapers
www.cogsci.princeton.edu/cgi-bin/webwn

a person who has some pathogen to which he is immune but who can pass it on to others
www.cogsci.princeton.edu/cgi-bin/webwn

a rack attached to a vehicle; for carrying luggage or skis or the like
www.cogsci.princeton.edu/cgi-bin/webwn

1. A company which provides transmission services. 2. A continuous electrical signal capable of being modified to carry information. The carrier carries no information until some component of the signal (amplitude, frequency or phase) is changed. These changes convey the information. (See also Amplitude Modulation, Frequency Modulation and Phase Modulation.)
www.rvcomp.com/wiring/EIA/glossary.htm

A person or animal without apparent disease who harbors a specific infectious agent and is capable of transmitting the agent to others. The carrier state may occur in an individual with an infection that is inapparent throughout its course (known as asymptomatic carrier), or during the incubation period, convalescence, and postconvalescence of an individual with a clinically recognizable disease. The carrier state may be of short or long duration (transient carrier or chronic carrier).
www.cdc.gov/nccdphp/drh/epi_gloss.htm

A company, such as any of the "baby Bell" companies, that provide network communications services, either within a local area or between local areas.

www.marconi.com/html/glossary/glossaryc.htm

A licensed company (network operator) may market any number of communication services for voice and data. Carriers offer their services to both end-customers (private or business) and other carriers. In the latter case, the service simply consists of transport capacity for long-distance traffic. For example, local/regional network operators will buy transport capacity from carriers that operate on a global basis.

www.3gnewsroom.com/html/glossary/c.shtml

A company which provides network transmission services or (b) a continuous electrical signal capable of being modified to carry information. The carrier carries no information until some component of the signal (amplitude, frequency or phase) is changed. These changes convey the information.

www.networkcables.com/c.htm

The representative or senator assigned by the committee chair to explain and speak in favor of a measure on the floor of the House or Senate and to answer questions about it. The carrier does not have to be a member of the committee in which the bill was heard. If, for example, a particular representative or senator is known to be knowledgeable or interested in a bill's issue, the committee chair, as a courtesy, might ask that member to carry the bill.

www.leg.state.or.us/glossary.html

A company that provides telecommunications circuits. Carriers include both local telephone companies and long distance providers.

www.incoming.com/s2glossary25.html

(n.) A special frequency or company providing telecommunications services.

docs.sun.com/db/doc/805-4368/6j450e60c

Practically all people who are HCV antibody positive 'carry' the virus. The term 'carrier' is often misused, though, to mean someone who has the hepatitis C virus yet is in good health. Mutate: When cells divide or viruses multiply, their genetic material must be copied. Sometimes mistakes are made when this happens and the resulting new cell or virus is different in some way. This is important for viruses because mutation can fool the immune system into not recognising the virus.

www.nevdgp.org.au/geninf/std_misc/hepc_glossary.htm

A company that provides telecommunications circuits. Carriers include the local telephone company and companies like AT&T, MCI, and Sprint.

www.develcon.com/kb/i015.htm

A carrier is a long distance company that uses primarily its own transmission facilities, as opposed to resellers which lease or buy most or all transmission facilities from carriers. Many people refer to any type of long distance company, whether it has its own network or not, as a carrier, so the term is not as restrictive as it used to be.

education.icn.siemens.com/doc/jobaids/glossary/test_C.htm

A company which owns or operates transmission facilities and offers telecommunication services to the general public.

www.cwta.ca/industry_guide/glossary.php3

Insurance company that actually underwrites and issues the insurance policy. The term refers to the fact that the company carries (or assumes) certain risks for the policyholder.

www.iid.state.ia.us/division/consumer/terms/default.asp

An electrical signal of a set frequency that can be modulated in order to carry data.

www.femf.org/education/Summit2000syll/ottglossary.htm

Telecommunications company which carries national long distance and /or international calls.
www.art-telecom.fr/glossaire/glossary.htm

(1) An insurance company which "carries" the insurance. (The terms "insurance company" or "insurer" are preferred because of the possible confusion of "carrier" with transportation terminology). (2) In transportation, the trucker, air carrier, ocean steamship company or other entity which moves the goods. (See "Contract Carrier")
www.allenins.com/Insurance_Definitions.html

A company, which owns or operates transmission facilities and offers telecommunication services to the general public.
www.expwireless.com/Glossary.htm

A telecommunications company that offers communications services.
www.routo.net/glossary.php

An individual who possesses one copy of a mutant allele that causes disease only when two copies are present. Although carriers not affected by the disease, two carriers can produce a child who has the disease. 1
www.geneticalliance.org/geneticissues/mediainfo/glossary.html

A modulated RF signal; that is, one which is carrying audio or other information. Sometimes used in a general manner to refer to any RF signal.
www.audio-technica.com/glossary/

A company that provides telecommunications services.
www.comparecellular.com/glossary.asp

The company providing transportation for your household goods and on whose interstate or intrastate operating authority the shipment is moved.
www.njmovers.com/glossary.htm

Originally used for a long distance company that leases the facilities to carry a call, the term is now used to describe companies that resell other services without leasing facilities. Generally, a carrier is the company who bills for calls under its own name.
www.payphone.com/glossary.htm

means the operator of any airline, railroad, motor carrier, shipping line, or other enterprise which is engaged in the business of transporting any animals for hire.
www.aphis.usda.gov/ac/cfr/9cfr1.html

The insurance company that underwrites and issues the insurance policy. The insurance company is said to carry the risk for the policyowner.
www.datalife.com/mall/pages/glossary/GLOSS_C.HTM

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File: PGPB

Aug 7, 2003

PGPUB-DOCUMENT-NUMBER: 20030149603

PGPUB-FILING-TYPE: new

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TITLE: System and method for operating a non-linear model with missing data for use in electronic commerce

PUBLICATION-DATE: August 7, 2003

INVENTOR-INFORMATION:

| NAME | CITY | STATE | COUNTRY | RULE-47 |
|-----------------|------------|-------|---------|---------|
| Ferguson, Bruce | Round Rock | TX | US | |
| Hartman, Eric | Austin | TX | US | |

US-CL-CURRENT: 705/7; 706/22

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KMIC | Draw D |
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File: PGPB

Jul 24, 2003

PGPUB-DOCUMENT-NUMBER: 20030140039

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20030140039 A1

TITLE: Pre-processing input data with outlier values for a support vector machine

PUBLICATION-DATE: July 24, 2003

INVENTOR-INFORMATION:

| NAME | CITY | STATE | COUNTRY | RULE-47 |
|-----------------|------------|-------|---------|---------|
| Ferguson, Bruce | Round Rock | TX | US | |
| Hartman, Eric | Austin | TX | US | |

US-CL-CURRENT: 707/4

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw D |
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File: PGPB

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PGPUB-DOCUMENT-NUMBER: 20030140023

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20030140023 A1

TITLE: System and method for pre-processing input data to a non-linear model for use in electronic commerce

PUBLICATION-DATE: July 24, 2003

INVENTOR-INFORMATION:

| NAME | CITY | STATE | COUNTRY | RULE-47 |
|-----------------|------------|-------|---------|---------|
| Ferguson, Bruce | Round Rock | TX | US | |
| Hartman, Eric | Austin | TX | US | |

US-CL-CURRENT: 706/21; 706/15

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw D |
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☐ 4. Document ID: US 20030139828 A1

L2: Entry 4 of 4

File: PGPB

Jul 24, 2003

PGPUB-DOCUMENT-NUMBER: 20030139828

PGPUB-FILING-TYPE: new

DOCUMENT-IDENTIFIER: US 20030139828 A1

TITLE: System and method for pre-processing input data to a support vector machine

PUBLICATION-DATE: July 24, 2003

INVENTOR-INFORMATION:

| NAME | CITY | STATE | COUNTRY | RULE-47 |
|-----------------|------------|-------|---------|---------|
| Ferguson, Bruce | Round Rock | TX | US | |
| Hartman, Eric | Austin | TX | US | |

US-CL-CURRENT: 700/53; 700/31, 700/47, 700/52

| Full | Title | Citation | Front | Review | Classification | Date | Reference | Sequences | Attachments | Claims | KWIC | Draw D |
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Rakesh Agarwal, Amrita Deo, Swati Das

March 2004 **ACM SIGSOFT Software Engineering Notes**, Volume 29 Issue 2Full text available: [pdf\(207.04 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#)

In this competitive era, education has become equally demanding and competitive. Innovation in the sphere of education has led to new ways of learning. Internet has now made learning dynamic by introducing the concept of learning through E-learning. The dynamism in E-Learning can be made more powerful with the help of intelligent agents. Intelligent, autonomous, mobile, rational, reactive, persistent and moreover proactive computer code so called as agents represent the next tidal wave of innova ...

Keywords: E-learning, agent, agent typology, effective education, intelligent agents**2 [Contributed articles: Resource description framework: metadata and its applications](#)**

K. Selçuk Candan, Huan Liu, Reshma Suvarna

July 2001 **ACM SIGKDD Explorations Newsletter**, Volume 3 Issue 1Full text available: [pdf\(1.02 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#)

Universality, the property of the Web that makes it the largest data and information source in the world, is also the property behind the lack of a uniform organization scheme that would allow easy access to data and information. A semantic web, wherein different applications and Web sites can exchange information and hence exploit Web data and information to their full potential, requires the information about Web resources to be represented in a detailed and structured manner. Resource Descrip ...

Keywords: Resource Description Framework (RDF), Web, XML, metadata, semantic web**3 [Optical character recognition for typeset mathematics](#)**

Benjamin P. Berman, Richard J. Fateman

August 1994 **Proceedings of the international symposium on Symbolic and algebraic computation**Full text available: [pdf\(741.91 KB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

There is a wealth of mathematical knowledge that could be potentially very useful in many computational applications, but is not available in electronic form. This knowledge comes in

the form of mechanically typeset books and journals going back more than a hundred years. Besides these older sources, there are a great many current publications, filled with useful mathematical information, which are difficult if not impossible to obtain in electronic form. What we would like to do is extract ...

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John Colter, Netscape Navigator

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"museum of natural history" "museum of modern art"

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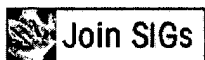
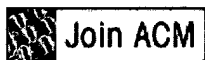
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1 [Micropipelines](#)

I. E. Sutherland

 June 1989 **Communications of the ACM**, Volume 32 Issue 6

Full text available: pdf(2.30 MB)

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The pipeline processor is a common paradigm for very high speed computing machinery. Pipeline processors provide high speed because their separate stages can operate concurrently, much as different people on a manufacturing assembly line work concurrently on material passing down the line. Although the concurrency of pipeline processors makes their design a demanding task, they can be found in graphics processors, in signal processing devices, in integrated circuit components for doing arithmetic ...

2 [Poster session 2: RESTA: a robust and extendable symbolic timing analysis tool](#)

Kundan Nepal, Hui-Yuan Song, R. Iris Bahar, Joel Grodstein

 April 2004 **Proceedings of the 14th ACM Great Lakes symposium on VLSI**

Full text available: pdf(147.25 KB)

 Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Successful timing analysis for high-speed integrated circuits requires accurate delay computation. However, full-custom circuits popular in today's CPU designs make this difficult. A good circuit-level static timing analysis tool should 1) consider both internally or externally specified input constraints; 2) handle a wide range of circuit structures; and 3) have a robust underlying framework that can be applied independent of the actual device model. In this paper, we present *RESTA*, a

Keywords: decision diagrams, input constraints, symbolic CAD, timing analysis

3 [New control structures to aid gotolessness](#)

D. M. Symes

 January 1975 **Proceedings of the 2nd ACM SIGACT-SIGPLAN symposium on Principles of programming languages**

Full text available: pdf(481.11 KB)

 Additional Information: [full citation](#), [abstract](#), [references](#)


This paper contains a suggestion for a calculus for constructing 'flowchartable' algorithms. The calculus is a generalization of an Algol-like calculus, and hence maintains some discipline over the algorithms constructible with it. The essence of the great 'go to' debate seems to be that the use of the 'go to' device allows the construction of 'spaghetti-like' algorithms which are difficult to control intellectually, and hence that only more restrictive, special-purpose

control structures (which ...

4 Latchup-aware placement and parasitic-bounded routing of custom analog cells

Bulent Basaran, Rob A. Rutenbar, L. Richard Carley

November 1993 **Proceedings of the 1993 IEEE/ACM international conference on Computer-aided design**

Full text available:  pdf(930.26 KB) Additional Information: [full citation](#), [references](#), [citations](#)



5 Hierarchical circuit extraction with detailed parasitic capacitance

Gary M. Tarolli, William J. Herman

June 1983 **Proceedings of the 20th conference on Design automation**

Full text available:  pdf(655.70 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper describes a hierarchical MOS layout verification program called IV. IV extracts a circuit netlist from a MOS layout and then compares this netlist to a reference circuit netlist obtained from a schematic. The circuit extraction phase of IV is described in detail. A unique characteristic of the program is the treatment of parasitic capacitance. IV is currently being used in a production environment to extract circuits in a variety of NMOS and CMOS processes.



6 Analytical approach to custom datapath design

Serkan Askar, Maciej Ciesielski

November 1999 **Proceedings of the 1999 IEEE/ACM international conference on Computer-aided design**

Full text available:  pdf(244.80 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper addresses the problem of layout design automation of datapath cells. We present a novel approach to transistor placement problem for custom datapath designs and demonstrate that it can be applied to practical designs. Our approach is based on an analytical model which employs a mixed integer linear programming (MILP) technique. The novelty and originality of the method is the efficient management of the complexity of the underlying mathematical model. Our prototype tool automatic ...



7 Transistor level placement for full custom datapath cell design

Durgam Vahia, Maciej Ciesielski

April 1999 **Proceedings of the 1999 international symposium on Physical design**


Full text available:  pdf(953.85 KB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)



8 A multitasking switchboard approach to user interface management

Peter P. Tanner, Stephen A. MacKay, Darlene A. Stewart, Marcell Wein

August 1986 **ACM SIGGRAPH Computer Graphics , Proceedings of the 13th annual conference on Computer graphics and interactive techniques**, Volume 20 Issue 4

Full text available:  pdf(691.16 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

A Switchboard model of user input management is presented which takes advantage of opportunities afforded by a multitasking multiprocessor programming environment. This model further separates application programming from the programming of the interaction dialogues as compared with conventional user interface management systems. It also provides powerful tools for implementing parallel forms of input, is suitable for managing interaction in window-based systems, and is very flexible. The paper d ...



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1 Latchup-aware placement and parasitic-bounded routing of custom analog cells



Bulent Basaran, Rob A. Rutenbar, L. Richard Carley

 November 1993 **Proceedings of the 1993 IEEE/ACM international conference on Computer-aided design**

 Full text available: pdf(930.26 KB) Additional Information: [full citation](#), [references](#), [citations](#)

2 Hierarchical circuit extraction with detailed parasitic capacitance



Gary M. Tarolli, William J. Herman

 June 1983 **Proceedings of the 20th conference on Design automation**

 Full text available: pdf(655.70 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

This paper describes a hierarchical MOS layout verification program called IV. IV extracts a circuit netlist from a MOS layout and then compares this netlist to a reference circuit netlist obtained from a schematic. The circuit extraction phase of IV is described in detail. A unique characteristic of the program is the treatment of parasitic capacitance. IV is currently being used in a production environment to extract circuits in a variety of NMOS and CMOS processes.

3 Transistor level placement for full custom datapath cell design



Durgam Vahia, Maciej Ciesielski

 April 1999 **Proceedings of the 1999 international symposium on Physical design**

 Full text available: pdf(953.85 KB) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#)

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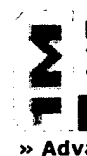
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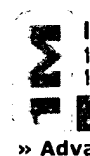
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| <u>L18</u> | L17 and independent with variable | 1 | <u>L18</u> |
| <u>L17</u> | merge with circuit with predetermined | 31 | <u>L17</u> |
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| <u>L13</u> | 4,813,077.pn. | 2 | <u>L13</u> |
| <u>L12</u> | "merge device" and predict\$5 | 10 | <u>L12</u> |
| <u>L11</u> | L7 and predict\$5 | 16 | <u>L11</u> |
| <u>L10</u> | L7 and data and preprocessing | 4 | <u>L10</u> |
| <u>L9</u> | L7 and "support vector machine" | 0 | <u>L9</u> |
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| <u>L5</u> | WO-9417482-A1.did. | 1 | <u>L5</u> |
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| <u>L4</u> | US-5729661-A.did. | 1 | <u>L4</u> |
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